collected still living among the carcasses of *P. virgo* which strewed the banks of the Garonne, we have not observed a single one the ovaries of which were not almost completely empty. On opening the abdomen after oviposition, we have only found a double sac of considerable capacity, formed by a membrane of extreme delicacy, receiving at its interior part a great number of ovigerous sheaths of three or four chambers containing an equal number of ova in course of formation. Other ova, more advanced in their development, and already furnished with the sort of hood or cap which covers the extremity opposite to that where the head of the embryo will be, are accumulated in greater or less numbers in the great sac into which the ovigerous sheaths open *.

Is there a special oviduct for each of these two sacs? Léon Dufour says that the sac which constitutes the ovary terminates posteriorly by a tubular neck, which unites with its congener to form a very short oviduct. Swammerdam says nothing of any such arrangement; nor have we ever seen any thing of the kind; so that we are more disposed to think that there are two oviducts as there are two penises, and that these two oviducts open separately, in the membrane which unites the seventh abdominal segment to the eighth.—*Comptes Rendus*, October 30, 1876, p. 809.

On the Nervous System and Muscles of the Echinida.
By M. L. Fredericq.

1. *Nervous System.*—Notwithstanding the labours of Tiedemann, Van Beneden, Krohn, J. Müller, Valentin, Baudelot, C. K. Hoffmann, and Lovén, the nervous system of the sea-urchins still presents many obscure points. The investigations that I made this summer at Roscoff on the nervous system of *Echinus sphæra* and *Toxopneustes lividus* have furnished the following results.

Anatomy.—The pentagonal nervous ring that surrounds the œsophagus, and the five ambulacral cords that start from it, are continued within a system of canals which has hitherto been unobserved. This anatomical peculiarity is easily verified, even without the aid of sections, on the cords which run along the ambulacral zones in the interior of the test. Here we find two greatly flattened superposed canals: the inner one is the ambulacral canal; the outer one, which is intimately united with the other, contains the ambulacral nerve in the form of a dark-coloured flattened ribbon. The nervous cord floats freely in this sheath, and is only kept in its place by the series of nervous branches which it emits on each side towards the base of the ambulacral vesicles. The envelope of the nervous system is firmly united, but only on the middle line, with

* Swammerdam remarked the extreme smallness of the eggs of the Ephemeræ: he says, "Ovula cæterum stupendæ sunt parvitatis, et vix animadverti queunt." It is, in fact, by this minuteness, that he explains the necessity of the long sojourn (*trienni spatio*) that the larvæ issuing from the eggs have to make in the water before changing into perfect insects (see 'Biblia Naturæ,' tom. ii. p. 255).

the membrane that lines the interior of the test; of this it seems to be only an expansion, and presents the same structure (epithelium without connective tissue).

The nervous ring has no relation with a supposed inferior vascular circle of the lantern. On its upper surface it presents a furrow which divides it incompletely into two concentric bands: the outer of these passes entirely into the ambulacral cords; the inner one takes only an insignificant part in this formation.

The ambulacral nervous cords, after having traversed the inner surface of the ambulacral zones and become gradually thinner, penetrate, in company with the ambulacral vessel, into the canal of the ocellar plate, and terminate there against the portion of the external integument which outwardly closes this canal. This nervous termination presents no traces of a crystalline lens, or of any optical apparatus justifying the retention for it of the name of eye given to it by Valentin and Forbes. I have not succeeded in demonstrating in it the least sensibility to light, whether artificial or solar, and concentrated by means of a lens. The spot of pigment described here is a pure fiction; in this respect the so-called oculiform points do not enjoy any privilege.

A series of branches spring, as is well known, at right angles from each side of the ambulacral trunk. Each of them issues by an ambulacral pore, penetrates into the ambulacral tentacle, traverses its length, and terminates beneath the sucking-disk at a pad serving as an organ of touch.

Histology.—There is no reason for establishing a division into ganglia and nerves in the nervous ring and the great trunks which start from it; all these parts have identically the same structure, and must be regarded as nervous centres.

Their brown coloration is due, not to scattered granules, as has hitherto been supposed, but especially to the presence of large irregular elongated cells (resembling the pigment-cells of the Batrachia) filled with brown birefringent bundles: the nucleus is very apparent; for its neighbourhood is destitute of pigment. I regard these cells as connective, seeing that I find them in other organs, especially in the walls of the aquiferous system, the membrane of the lantern, &c. The nervous elements proper have already been described by Baudelot and C. K. Hoffmann. They are fibrillæ of extreme tenuity and small bipolar cells. I have found that these fibres and cells form two very distinct layers. The inner layer presents only fibres; the outer layer (that which is turned towards the test) has a granular appearance. Examined under a high power it shows an immense number of very small cells, only measuring a few thousandths of a millimetre. These cells are so pressed against each other that at the first glance we seem to have to do with an epithelium; but on examining them with more attention, and especially by exerting a slight pressure on the tissue while still fresh, the cells separate from each other, and each of them shows two very thin prolongations, which, at a certain distance from the cells, present absolutely the aspect of the fibrillæ of the inner layer. The

direction of these prolongations is variable. At the level of the median furrow presented by each of the ambulacral cords it is exactly transverse. We can then trace these prolongations even into the branches destined for the ambulacral tentacles. I may add that these cells are formed of a not very abundant homogeneous grey protoplasm surrounding a large clear nucleus. The cellular layer adheres intimately to the fibrous layer, so that they can only be separated from each other in the state of little fragments.

2. *Muscles.*—The most contradictory statements prevail with regard to the structure of the muscles of the sea-urchins. I have been able to ascertain that they are composed of very thin cylindrical fibres, perfectly smooth and homogeneous in the direction of their length. Thus, even by employing alcohol, osmic acid, hæmatoxylin, chromic acid, &c., I have not been able to discern the least trace of a transverse stria. These fibres present a fibrillar structure, and frequently one or more elongated nuclei applied to their surface; but they appear to be destitute of an enveloping membrane. They are birefringent and become vividly impregnated with colouring matters and osmic acid.

The fibres of the muscles of the lantern of Aristotle are implanted directly by a denticulated extremity upon the calcareous parts of the skeleton.

The muscles of the lantern and the muscular organs (intestine, ambulacral vesicles) undergo energetic contractions under the influence of electrical or mechanical excitation; but these contractions do not take place suddenly as in the case of striated muscles. It is very difficult to demonstrate the existence of the nerves which animate these muscles.—*Comptes Rendus*, Nov. 6, 1876, p. 860.

Physiological Experiments on the Functions of the Nervous System in the Echinida. By M. L. Fredericq.

By means of fine-pointed scissors five small cuts were made in the buccal membrane of an *Echinus lividus*, in such a manner as to divide the ambulacral nervous trunks near their origin in the collar. The ambulacral feet were not at all paralyzed; they moved in all directions and attached themselves to surrounding bodies; but the animal could no longer execute general movements or change its position, whilst other uninjured individuals could walk along the bottom of the aquarium and crawl up its glass front.

If an uninjured *Echinus* be turned so that its mouth is upwards, it moves its ambulacral feet until, in a few seconds or minutes, it will assume its normal position. After section of the ambulacral nerves the animal could no longer execute this combined movement, but remained indefinitely in its abnormal position. This is the effect of an insignificant mutilation. On the other hand the most serious lesions, if they do not reach the central nervous system, by no means prevent the urchins from using their ambulacral feet in the ordinary way; they turn themselves perfectly after many inci-